3.0 AFFECTED ENVIRONMENT

3.1 Introduction

The 1999 LANL SWEIS (DOE 1999) described the existing environment of the Los Alamos area; however, the Cerro Grande Fire altered many of the existing conditions both at LANL and in the surrounding area. These effects are only partially known at this time. Ongoing evaluations conducted over the next several years will increasingly refine DOE's understanding of the short- and long-term effects of the fire on various resources. Primarily, the fire destroyed vegetation and altered soil characteristics in the upper portions of several watersheds above LANL. As a consequence, the amount of storm water runoff for a given rain event has increased substantially. The rate, duration, and location of the rain event will determine the energy of the runoff and whether soils and sediments will be deposited or eroded. The higher energy expected for some runoff events will result in the flow entraining larger than normal amounts of fire-damaged vegetation debris, soil, sediments, and rock. Some sediments may contain low levels of radionuclides, heavy metals, and other contaminants. These effects are expected to continue at least for three to five years. Other long-term changes (five years or more) resulting from the fire include changes in habitat for T&E species and other biotic resources, in cultural resources, and in the visual environment. Floodplains and wetlands, air quality, waste management, environmental restoration, socioeconomics, transportation, and human health were all affected to some extent in the short term (less than five years).

Watersheds are natural boundaries that provide a commonality for describing multiple resource effects, including ecological resources, analysis, and management. The complex canyon and mesa topography and pronounced elevational gradients of the LANL region are particularly well suited for discussion about ecological impacts within regional watersheds. Watersheds provide the following descriptive benefits:

- relatively discrete landscape units with a hierarchical structure;
- relatively closed systems in terms of many ecological components and processes such as hydrologic regime, nutrient cycling, contaminant transport, erosion, and sedimentation;
- provide an ecologically consistent template for organizing information on ecosystem components, such as landscape-wide vegetation zones as well as resident and migratory wildlife populations (including T&E species and wetlands).

The following sections summarize the environmental baseline at LANL and in the surrounding geographic areas of concern, or the ROI as discussed in the 1999 LANL SWEIS, changes that are expected under the Expanded Operations Alternative selected in the SWEIS ROD, and changes as a result of the fire to the extent that they are now known or estimated. The boundaries of the ROI depend on the resource under consideration. For hydrology, for example, the ROI includes all the watersheds affected by the fire and the Rio Grande to the point where it enters Cochiti Reservoir. The ROI for environmental restoration, in contrast, consists of LANL and the area immediately downstream.

3.2 Land Use

Section 4.1.1 of the 1999 LANL SWEIS provides a detailed description of land use in the region and at LANL before the Cerro Grande Fire. Land use in and around LANL under the Preferred Alternative selected in the SWEIS ROD is described in detail in Section 5.3.1.1 of the SWEIS. The ROI includes LANL, Los Alamos, White Rock, and surrounding Forest Service and National Park Service lands.

Land use in this region consists of the Los Alamos and White Rock townsites, which primarily include residential, commercial, light industrial, and recreational facilities. Land use within LANL is described within LANL's Comprehensive Site Plan 2000 (LANL 2000c) and includes the following types of land use: administration, experimental science, high explosive testing and research and development, nuclear materials research and development, physical/technical support, public/corporate interface, theoretical/computational science, waste management, and reserve areas that provide an environmental and security buffer.

Land uses in the region are temporarily affected by the Cerro Grande Fire. During the period from the beginning of the fire to some point probably about two to three years in the future in at least part of LANL and the surrounding forest lands, access and use of certain recreation areas and trails is restricted. Fires within LANL, particularly in the buffer zones, reduced the amount of vegetation that provided part of the human health and safety and security buffer function.

One of the primary land use zones within Los Alamos townsite is residential. About 230 housing units in that zone were totally destroyed (Photo 3.1). Within LANL, the structures that were totally destroyed, including trailers, transportables, and storage units, numbered about 40 (personal communication, H. Nunes).

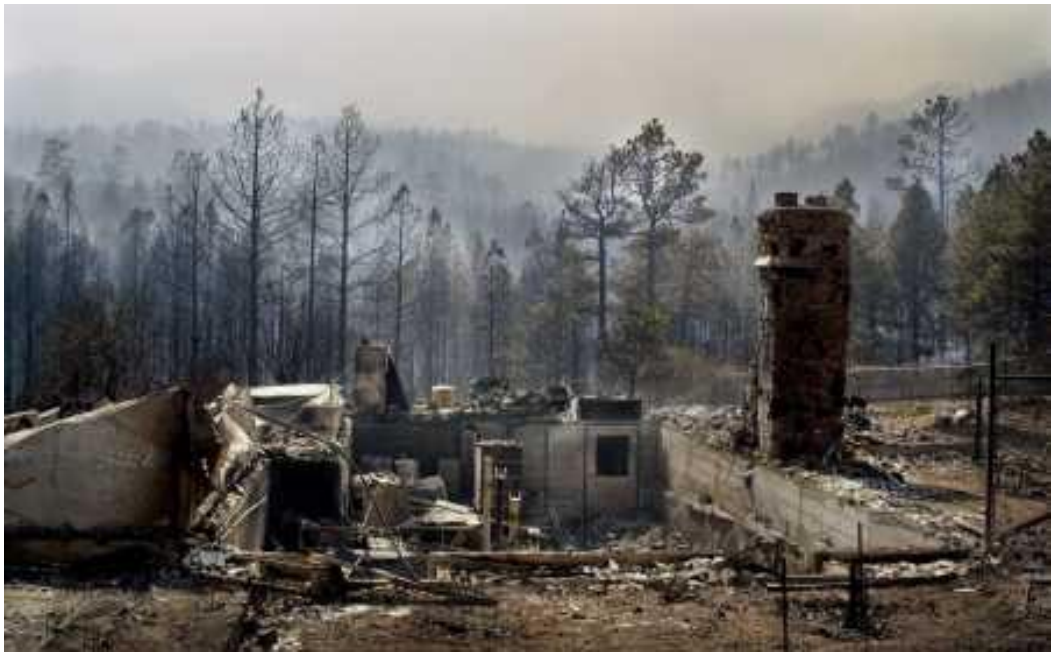

PHOTO 3.1—*Burned Residential Unit in Los Alamos Townsite*

3.3 Geology and Soils

3.3.1 Geology

The 1999 LANL SWEIS (DOE 1999) discusses the history of regional volcanism and seismic activity, predictions of future volcanic activity, seismic hazard analysis, and studies on fault rates and terminations. The SWEIS also discusses slope stability as a function of canyon wall steepness, canyon depth, and geologic stratigraphy. The ROI for geological resources consists of the entire burned area and LANL areas where various fire suppression and post-fire activities occurred. Although the Cerro Grande Fire had no effects on volcanism and seismic activity, there have been impacts on slope stability. Increased soil erosion caused by loss of canopy and ground cover during the fire has destabilized rocks close to the edges of mesas, mesa sideslopes, and canyon bottoms. One example of this phenomenon occurred on LANL immediately west of SR 501 on June 28, 2000, where geologic parent materials, originally lying beneath alluvium and soils, were uncovered and transported downstream.

3.3.2 Soils

The 1999 LANL SWEIS (DOE 1999) described the soil series on the mesa tops and their geochemistry, soil monitoring of radionuclides and heavy metals, and soil erosion as the mechanism for moving contaminants. The Cerro Grande Fire destroyed much of the forest canopy cover (see discussion in Section 3.4 and Table 3.1) and ground cover above these soils, thus increasing their susceptibility to erosion. In addition, the fire also altered soil characteristics that further increased the erosion potential.

The BAER Team used the Universal Soil Loss Equation (USLE) to assess potential soil erosion from field locations varying in burn severity, aspect, vegetation type, and a microclimate vegetation modifier (Figures 3.1 and 1.3 [see page 1-9]). These estimates of soil erosion for the soils in the entire burn area were derived from the Santa Fe National Forest soil survey, which contained estimates of USLE erosion rates (based on a limited set of factors) for potential conditions with no canopy and ground cover, such as those that occurred as a result of the fire. Before the fire, UC staff studied a portion of the burn area outside LANL using the full set of USLE factors. Soil erosion was estimated to be greater than the Santa Fe National Forest survey predicted (LANL 2000d).

By creating hydrophobic soils, the Cerro Grande Fire also affected the hydrologic functions of these soils in a manner that further enhanced potential erosion. There is a close correlation between these hydrophobic soil properties and the amount of heat experienced by the soil and the residence time of the heat in contact with the soil. The development of hydrophobic soils is a factor in assigning a high-burn severity designation (Figures 3.2 and 1.3).

3.3.2.1 Post-fire Acreage of Hydrophobic Soils

The ROI for soil issues is defined as the entire area burned by the Cerro Grande Fire (see Figure 1.2, page 1-3) and the LANL areas where DOE activities took place. Hydrophobic soils are scattered throughout this area generally in the upper elevations of the Jemez

Mountains. They are usually limited to areas with a high-burn severity (Figure 3.2). Hydrophobic soils occurred on a total of about 9,310 ac (3,724 ha) of the 14,510 ac (5,804 ha) in the high-burn severity category. No large areas of hydrophobic soils were found within LANL (Figure 3.2).

3.3.2.2 Post-fire Acreage of Hydrophobic Soils by Watershed

The Cerro Grande Fire extended across 16 canyons (see Figure 1.2, page 1-3), burning from 103 ac (42 ha) in Frijoles Mesa Canyon to 6,553 ac (2,651 ha) in Guaje Canyon as shown in Table 3.1. Five of these canyons contained no detectable hydrophobic soils. Rendija Canyon contained the largest acreage of hydrophobic soils (1,917 ac [767 ha]), and Pueblo Canyon contained the largest percentage of hydrophobic soils (51.8 percent) relative to the acres burned in this watershed.

TABLE 3.1—*Burned Areas and Hydrophobic Soils in each Watershed Affected by the Cerro Grande Fire*

Watershed	Area Burned ac/ha	Hydrophobic Soils ac/ha	% Hydrophobic Soils
Los Alamos Canyon Watershed			
Los Alamos Canyon	2,922/1,169	661/264	22.6
Pueblo Canyon	1,602/641	829/332	51.8
Rendija Canyon	4,476/1,790	1,917/767	42.8
Guaje Canyon	6,553/2,621	1,314/526	20.1
Pajarito Canyon Watershed			
Pajarito Canyon	5,179/2,072	940/376	18.2
Mortandad Canyon Watershed			
Mortandad Canyon	1,343/537	0/0	0.0
Cañada del Buey	422/169	0/0	0.0
Water Canyon Watershed			
Water Canyon	4,918/1,967	737/295	15.0
Potrillo Canyon	234/94	0/0	0.0
Cañon de Valle	2,057/823	94/38	4.6
Sandia Canyon Watershed			
Sandia Canyon	407/163	0/0	0.0
Other Watersheds			
Chupaderos Canyon	2,005/802	508/203	25.4
Frijoles Mesa Canyon	103/41	0/0	0.0
Frijoles Canyon	1,145/458	52/21	4.6
Garcia Canyon	3,714/1,485	923/369	24.8
Santa Clara Canyon and Tributaries	5,886/2,354	1,335/534	22.7

3.4 Water Resources

The affected hydrological environment considered by this analysis includes baseline surface and subsurface water quality and quantity conditions as well as changes resulting from the Cerro Grande Fire.

3.4.1 Surface Water

The ROI for surface water issues extends from the crest of the Sierra de los Valles down to Cochiti Reservoir, which includes the five watersheds discussed in detail in this SEA (see Figure 2.1, page 2-3). Section 4.3.1 of the 1999 LANL SWEIS (DOE 1999) describes surface water conditions on LANL before the Cerro Grande Fire. Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams. Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the LANL site before they are depleted by evaporation, transpiration, and infiltration. Runoff from thundershowers or snowmelt reaches the Rio Grande, the major river in north-central New Mexico, several times a year in some drainages. Effluents from sanitary sewage, industrial waste water treatment plants, and cooling-tower blowdown enter some canyons at rates sufficient to maintain surface flows for varying distances.

High- and moderate-severity fire increases the potential for surface runoff and soil erosion by removing vegetation and surface organic layers and increasing soil hydrophobicity. The Cerro Grande Fire increased the potential for storm water runoff through the canyons that cross LANL property. Table 3.2 shows estimated pre-fire and post-fire peak flows and total volume for storm water runoff in canyons on LANL (Rae 2000a and 2000b). Estimates are based on a six-hour storm with a 100-year return period, which is the event used by DOE at LANL for siting new construction and which has been used in various NEPA analyses including the 1999 LANL SWEIS. Estimated post-burn peak flows in Pueblo Canyon, one of the most severely burned, were almost 16 times greater than pre-burn. Soil erosion rates and sediment loads from these burned areas are also expected to be much greater than pre-fire levels for many years, depending on the success of soil erosion control structures and vegetation recovery (see Section 3.3, page 3-3). Fire also mineralizes organic nitrogen, which can produce a flush of nitrate into surface and shallow groundwater and a subsequent temporary reduction in water quality. Total suspended solids will also increase and temporarily reduce surface water quality.

TABLE 3.2—*Hydrological Model Output Estimates for Burned Watersheds*

Watershed	Pre-burn Peak Flow (ft^3/s^{-1} / m^3/h^{-1})	Post-burn Peak Flow (ft^3/s^{-1} / m^3/h^{-1})	Volume (acre-ft/ha-m)
Los Alamos			
LA Canyon:			
at Reservoir		2,216/225,800	476/58
at Omega Bridge	532/54,200	2,182/222,300	529/65
Pueblo Canyon:			
at Diamond Dr.	206/21,000	3,276/333,800	297/36
at LA Canyon		1,072/109,200	420/52
below Pueblo Canyon	589/60,000	1,299/132,400	1,006/124
Pajarito			
Pajarito Canyon:			
at SR 501	146/14,900	2,063/210,200	235/29
below Two Mile		2,806/285,900	60/7
TA-18		2,492/253,900	673/83
at SR 4		1,881/191,700	638/78
Mortandad			
Mortandad at LANL boundary	35/3,600	264/26,900	N/A
Cañada del Buey at SR 4	72/7,300	90/9,200	41/5

TABLE 3.2—*Continued*

Watershed	Pre-burn Peak Flow (ft^3/s^{-1} / m^3/h^{-1})	Post-burn Peak Flow (ft^3/s^{-1} / m^3/h^{-1})	Volume (acre-ft/ha-m)
Water Canyon			
Water Canyon at SR 501	264/26,900	1,849/188,400	289/36
Cañon de Valle at SR 501	147/15,000	714/72,800	147/18

Estimates based on EES-15/ESH-18 hydrologic estimates of a six-hour storm with a 100-year return period. Pajarito Canyon estimates were revised following the June 28 runoff event. Pre-burn estimates are not available for all locations. Cubic meters per hour is m^3/h^{-1}. Cubic feet per second is ft^3/s^{-1}.
Source: Conversions taken from the Soil Science Society of America Journal.

The BAER Report did not identify any large areas of hydrophobic soils on DOE property (see Figure 3.2, page 3-5). The primary source of runoff, therefore, is from the slopes of the Jemez Mountains west of LANL. On-site generation of runoff is not expected to make a major contribution to peak flows through the canyons on LANL.

3.4.2 Groundwater

Section 4.3.2 of the 1999 LANL SWEIS describes groundwater conditions on LANL before the Cerro Grande Fire. Intermediate perched groundwater bodies of limited extent occur beneath the alluvium in portions of Pueblo, Los Alamos, and Sandia Canyons; in volcanic rocks on the sides of the Jemez Mountains to the west of LANL; and on the western portion of the Pajarito Plateau. Undiscovered intermediate perched groundwater bodies may exist, as the drilling coverage for these groundwater bodies has been relatively limited. Springs in the LANL area flow from alluvial and intermediate perched groundwater bodies and the main aquifer. Springs can be found in Water, Guaje, Pueblo, Los Alamos, Pajarito, Frijoles, and White Rock watersheds.

The Cerro Grande Fire has removed vegetation over large areas of individual watersheds. This is likely to result in an increase in runoff and a substantial reduction in plant transpiration of water from upland soils. Over a period of three to five years, this could lead to an increase in perched groundwater and springs within the ROI. Over the long term, this situation is likely to revert to pre-fire conditions. Additionally, as noted, fire mineralizes organic nitrogen, which can produce a flush of nitrate into surface and shallow groundwater and a subsequent temporary reduction in water quality.

The main aquifer is separated from alluvial and intermediate perched zone groundwater bodies by 350 to 620 ft (107 to 189 m) of unsaturated volcanic tuff and sediments. Recharge of the main aquifer is not fully understood nor characterized. The effects of the Cerro Grande Fire on intermediate and deep groundwater are unknown.

3.5 Floodplains and Wetlands

The Cerro Grande Fire removed vegetation from many of the watersheds on the eastern side of the Pajarito Plateau (see Table 3.1, page 3-6). Many of these watersheds are on or above LANL and other areas are adjacent to LANL. This section considers the existing floodplains and wetlands within the LANL boundaries. The ROI for floodplains and wetlands includes floodplains and wetlands with LANL boundaries and those downstream from LANL.

The loss of vegetation on these watersheds will result in more runoff reaching the canyon bottoms. More runoff in the canyons will result in the transport of greater than normal amounts of debris, including fire-damaged vegetation and soil.

In normal years, large amounts of rain falling in or above Los Alamos would likely not reach the Rio Grande. However, following the fire many of these canyons will probably transport water and debris to the Rio Grande after very heavy rain events.

3.5.1 Floodplains

DOE had delineated all 100-year floodplains within LANL boundaries before the Cerro Grande Fire (Figures 3.3 through 3.7) in accordance with requirements presented in RCRA (40 CFR Part 270) and Executive Order 11988—Floodplain Management (1999 LANL SWEIS). Due to increased runoff as a result of the fire, all of the floodplain areas in and below burn areas indicated in Figures 3.3 through 3.7 have increased (under unmodified conditions). The amount of increase will depend on the amount of vegetation mortality, soil conditions, slope, and other factors. In rainstorms, more water will reach the canyon bottoms than normally would occur. Depending on the character of the runoff event, the floodplains could be affected by erosion or deposition.

Overall, most LANL development is on mesa tops, and development within canyons is light; however, there are a number of structures within the 100-year floodplain. Most may be characterized as small storage buildings, guard stations, wellheads, water treatment stations, and light laboratory buildings. There are no waste management facilities in the 100-year floodplain. Some facilities are characterized as moderate hazard due to the presence of sealed sources or x-ray equipment, but most are low-hazard radiological facilities or have been assigned no hazard designation. The Solution High-Energy Burst Assembly Building at TA-18 is within the Pajarito Canyon 100-year floodplain. The 500-year floodplain has been designated only for Los Alamos Canyon. The Omega-West reactor (inactive) is located within this 500-year floodplain and is classified as a low-hazard radiological facility. Depending on the character of the runoff event, structures and facilities located in floodplains could be affected by erosion or silt and debris deposition.

3.5.2 Wetlands

Wetlands are transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. LANL has wetlands that were identified by the National Wetlands Inventory, conducted by the U.S. Fish and Wildlife Service (USFWS) in 1990, as well as other wetlands that have been identified subsequent to the 1990 Inventory.

Wetlands must have the following attributes: at least periodically, the land supports predominantly hydrophytes (plants adapted to abundant water such as cattails and willows); the substrate is predominantly undrained hydric soil (e.g., marshes, wet meadows); and is saturated with water or covered by shallow water at some time during the growing season of each year (USACE 1987). Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates (e.g., insects). Wetlands also

potentially contribute to the overall habitat requirements of the Mexican spotted owl, southwestern willow flycatcher, and spotted bat, all of which are federal- or state-listed species, or both. Wetlands also provide habitat, food, and water for many common species such as deer, elk, small mammals, and many migratory birds and bats. The majority of the wetlands in the LANL region are associated with canyon stream channels or are present on mountains or mesas as isolated meadows containing ponds or marshes, often in association with springs or seeps.

There are a total of 77 ac (31 ha) of wetlands at LANL. More than 95 percent of the identified wetlands are located in the Sandia, Mortandad, Pajarito, and Water Canyons watersheds (1999 LANL SWEIS). During the Cerro Grande Fire, 20 percent or 16 ac (6.5 ha) of the wetlands identified were burned at a low or moderate intensity. No wetlands within LANL were severely burned. Additional riparian areas along the drainages burned during the fire; however, these are not wetlands and are not included in the total acres of wetland.

During a fire, the surface vegetation is destroyed. If the fire does not last too long or is not too intense, the vegetation will grow back within the same growing season. If the area of the wetland is severely burned, the vegetation may take several years to return. A flood event of sufficient energy could scour out or channelize the streambed and either damage or destroy the wetlands. Wetland areas could receive increased sediment from runoff as well. Small amounts of sediment from the burned area will enhance wetland growth due to nutrients in the ash. However, large amounts of deposited sediment can permanently alter the condition of existing wetlands and destroy them. The effects of the Cerro Grande Fire on LANL wetlands have not yet been fully assessed.

3.5.2.1 By Watersheds

Los Alamos Canyon Watershed

Most of the vegetation in Los Alamos Canyon upstream of LANL was destroyed during the fire. Most of the vegetation in Pueblo Canyon upstream of Diamond Drive in Los Alamos townsite was also destroyed. The Forest Service and the County of Los Alamos either administer or own lands in upper Pueblo Canyon. However, DOE administers some of the lower portions of Pueblo Canyon and had many activities in this canyon in the past. On DOE-administered land, the Los Alamos Canyon watershed had 1.24 ac (0.50 ha) of the floodplain burned at low-intensity while 7.42 ac (3 ha) were burned severely. Vegetation mortality is shown in Table 3.3 and Figure 3.3 (page 3-10).

TABLE 3.3—*Vegetation Mortality on Floodplains by Watershed*

Watershed	Vegetation Mortality			
	Low 10% to 40% (ac/ha)	Moderate 40% to 70% (ac/ha)	Severe 70% to 100% (ac/ha)	Total per Watershed (ac/ha)
Los Alamos	1.24/0.50	NA	7.42/3.00	64.01/25.90
Pajarito	72.76/29.45	2.32/0.94	0.24/0.10	176.65/71.49
Sandia	1.58/0.64	NA	NA	102.82/41.61
Mortandad	54.58/22.09	8.55/3.46	NA	124.17/50.25
Water	66.51/26.92	6.77/2.74	NA	345.54/139.84
Total Type	**196.67/79.60**	**17.64/7.14**	**7.66/3.10**	**813.19/329.09**

Because of the potential for increased runoff, the floodplain has been greatly increased in Los Alamos and Pueblo Canyons. Because of increased size of the floodplain, any rain event in the watershed will have greater than normal runoff and erosion. Additional debris and ash left from the fire will also be transported down the canyons during rainstorms.

No wetlands were directly burned in the Los Alamos Canyon watershed. However, riparian areas burned in the upper portions of the DOE portions of this watershed. Riparian areas are areas directly adjacent to the stream bottom that require water to be present only temporarily during the year. The riparian areas usually receive stream flow intermittently during the rainy season or in the spring after snow begins to melt. Wetlands in the watershed are likely to receive increased runoff.

Pajarito Canyon Watershed

There was significant mortality of vegetation in the upper portions of this watershed west of LANL. The upper watershed suffered mostly high damage to vegetation while the lower portion had low and moderate vegetation damage. In the LANL portion of the watershed, 72.76 ac (29.45 ha) burned at a low intensity, 2.32 ac (0.94 ha) were burned moderately, and 0.24 ac (0.10 ha) was severely burned. Because of the fire in the watershed, the size of the Pajarito, Two Mile, and Three Mile Canyons floodplain has increased (see Figure 3.6, page 3-13). Because of increased size of the floodplain, any rain event in the watershed will cause greater than normal runoff and erosion. Stormwater runoff will carry additional debris and ash left from the fire down the canyons.

Wetland vegetation totaling 1.24 ac (0.5 ha) burned in the Pajarito Canyon watershed, suffering a 10 percent to 40 percent vegetation mortality. The wetlands that burned were only small areas of hydrophytic vegetation immediately surrounding isolated springs. Riparian areas also burned in the upper portions of the LANL portion of this watershed. None of the large wetlands in the lower portions of the watershed burned. As in other canyons, the wetlands in the watershed are likely to receive increased runoff.

Other Watersheds

Sandia Canyon Watershed

In the Sandia Canyon watershed, about 1.58 ac (0.64 ha) of floodplain burned at a low intensity (see Figure 3.4, page 3-11). The areas of this watershed that burned were patchy and were not large contiguous areas. There should be little effect to the floodplain in Sandia Canyon.

No wetlands were directly burned in the Sandia Canyon watershed. However, wetlands in the watershed are likely to receive increased runoff.

Mortandad Canyon Watershed

There was significant mortality of vegetation in the Mortandad Canyon watershed. The upper watershed suffered mostly moderate damage to vegetation while the lower portion

had severe vegetation loss. In the watershed, there were 54.58 ac (22.09 ha) of floodplain vegetation with low-intensity burn and 8.55 ac (3.46 ha) were moderately burned (see Table 3.3, page 3-15). Because of the fire in the watershed, the size of the Mortandad Canyon and Cañada del Buey floodplain has increased (see Figure 3.5, page 3-12). Because of increased size of the floodplain, any rain event in the watershed will have greater than normal runoff and erosion. Additional debris and ash left from the fire will also be transported down the canyons during the rainstorms.

A total of 4.78 ac (1.93 ha) of wetlands vegetation in the Mortandad watershed were burned. Specifically, about 2.98 ac (1.2 ha) suffered a 10 percent to 40 percent vegetation mortality, while 1.8 ac (0.73 ha) suffered a 40 percent to 70 percent vegetation mortality. In addition, riparian areas burned in the upper portions of this watershed. The wetlands in the watershed are likely to receive increased runoff.

Water Canyon Watershed

There was significant loss of vegetation in the upper portions of this watershed west of LANL. However, the size of the upper watershed west of LANL is relatively small compared to Los Alamos and Pajarito Canyons watersheds. The upper watershed suffered mostly severe damage to vegetation while the lower portion had low and moderate vegetation mortality. On the LANL portion of the watershed, 66.51 ac (26.92 ha) of the floodplain burned at low-intensity while 6.77 ac (2.74 ha) were moderately burned (see Table 3.3, page 3-15). Because of the fire in the watershed, sizes of the Water and Potrillo Canyons floodplain have increased (see Figure 3.7, page 3-14). Because of increased size of the floodplain, any rain event in the watershed will cause greater than normal runoff and erosion. Stormwater runoff will carry additional debris and ash left from the fire down the canyons.

A total of about 9.83 ac (3.98 ha) of wetlands vegetation in the Water Canyon watershed were burned. Specifically, 7.67 ac (3.1 ha) of wetland vegetation suffered a 10 percent to 40 percent vegetation mortality and 2.16 ac (0.88 ha) suffered a 40 percent to 70 percent vegetation mortality. All of the wetlands areas were in upper Cañon de Valle. The burned wetlands were large areas of hydrophytic vegetation in the canyon bottom. In addition, riparian areas burned in the upper portions of the LANL portion of this watershed. The wetlands in the watershed are likely to receive increased runoff.

3.6 Biological Resources

LANL is located in a region of diverse landform, elevation, and climate—features that contribute to producing diversified plant and animal communities. Plant communities range from urban and suburban areas to grasslands, wetlands, shrublands, woodlands, and mountain forest. These plant communities provide habitat for a variety of animal life. Animal life includes herds of elk (Photo 3.2) and deer, bear, mountain lions, coyotes, rodents, bats, reptiles, amphibians, invertebrates, and a myriad of resident, seasonal, and migratory bird life. In addition, T&E species, species of concern, and other sensitive species occur at LANL. Because of restricted access to certain LANL areas, lack of permitted hunting, and management of contiguous Bandelier National Monument and

Forest Service lands for natural biological systems, much of the region functions as a de facto refuge for wildlife.

PHOTO 3.2—*Elk Calf in the Los Alamos Area*

Section 4.5.1 of the 1999 LANL SWEIS provides a detailed summary of the ecological resources in and around LANL before the Cerro Grande Fire. The ROI is also described in this section. The impacts on the ecological resources in and around LANL under the Preferred Alternative selected in the SWEIS ROD are described in detail in Section 5.3.5. DOE and UC have developed a LANL Threatened and Endangered Species Habitat Management Plan in consultation with USFWS that delineates the habitat of T&E species. This management plan contains guidelines for managing LANL activities so as to limit potential effects on these species and their potential habitat within LANL.

3.6.1 ROI

3.6.1.1 Habitat Changes

Table 3.4 lists the total vegetation mortality within LANL.

TABLE 3.4–*Total Percentage of Vegetation Mortality on LANL within each Vegetation Zone*

Land Cover Type	Total Area (ac)	Vegetation Mortality (%)			
		0 to 10	10 to 40	40 to 70	70 to 100
Mixed Conifer	829.52	43.84	49.43	2.51	4.22
Aspen	40.90	21.44	49.10	28.95	0.51
Ponderosa Pine	8,174.09	45.59	47.33	5.74	1.34
Piñon/Juniper	12,930.17	89.08	9.71	1.19	0.02
Juniper Woodland	986.11	98.46	1.30	0.23	0.01
Grassland	1,815.46	47.83	45.63	6.53	0.01

The Cerro Grande Fire burned approximately 43,150 ac (17,261 ha). Preliminary results indicate that about 34 percent of those acres were burned with low severity (i.e., burn severity relates to the fire's impact on soil features), 8 percent with moderate severity, and about 58 percent with high severity. The fire created a habitat mosaic that is dynamic and will offer changing opportunities for plant and animal communities.

One of the BAER Team restoration activities of the burned area west of LANL includes reseeding efforts. The mixture of seeds being used for the reseeding effort contains two nonnative species (BAER 2000). These reseeding efforts in addition to other post-fire ecological conditions may alter the vegetative composition and abundance of the burned area from those of the pre-fire conditions.

3.6.1.2 Threatened and Endangered Species Conditions

The results of the Cerro Grande Fire will likely not cause a long-term change to the overall number of federally-listed T&E species inhabiting the region. However, the results of the fire will likely change the distribution and movement of various species, including the Mexican spotted owl. In the July 21, 2000, Federal Register, the USFWS proposed to designate 13.5 million ac (5.5 million ha) as critical habitat for the Mexican spotted owl within portions of the western U.S. (65 FR 141). Several canyons adjacent to LANL have been proposed as critical habitat. However, there are no areas on LANL that have been proposed as critical habitat. The areas off LANL that have been proposed as critical habitat suffered heavy damage during the Cerro Grande Fire. Specifically, two primary areas considered as critical habitat for the Mexican spotted owl located on Forest Service land near LANL suffered almost 100 percent vegetation mortality. The fire may also have long-term effects to the habitat of several state-listed species, including the Jemez Mountains salamander.

3.6.1.3 Other Wildlife

The Cerro Grande Fire dramatically altered the habitat of many species. While eliminating or fragmenting the habitats of many wildlife species (e.g., reptiles, amphibians, invertebrates, small mammals, birds), the effects of the fire will also increase and improve habitat for other species (e.g., large mammals) by creating more foraging areas. During the fire, individuals of many wildlife species died. Population recovery is expected within the next several breeding seasons. Elk and deer populations are expected to increase in the next years in response to the additional foraging areas resulting from post-fire vegetation regrowth around Los Alamos County.

3.6.2 LANL-Wide

3.6.2.1 Habitat Changes

The Cerro Grande Fire burned approximately 7,650 ac (3,061 ha) on LANL lands. Table 3.5 shows the percentage of vegetation mortality within each watershed. Depending on the fire intensity (fire intensity relates to the fire's impact to vegetation), existing vegetation will either be replaced by new species or will recover in a relatively short time period. In areas of moderate- to high-fire intensity where trees and understory species

were destroyed, a recolonization of different species may occur. In areas of low to moderate intensity, the existing species may recover quickly, depending on precipitation and other weather factors. However, these areas will probably look quite different because old dead material and detritus have burned and because burned materials released nutrients that will stimulate a productive growth spurt. As vegetation proceeds through the natural course of succession in the burned areas, there will also be a corresponding change in the diversity, composition, and numbers of wildlife species utilizing those areas. Much of this vegetation may be high in nutrients and very attractive to foraging species.

TABLE 3.5–*Total Percentage of Vegetation Mortality within Selected Watersheds at LANL*

Watershed percent vegetation mortality	Mixed Conifer (%)	Aspen (%)	Ponderosa Pine (%)	Piñon/ Juniper (%)	Juniper Woodland (%)	Grassland (%)
Los Alamos Canyon						
0 to 10	54.98	0	76.36	99.90	99.66	100.00
10 to 40	1.54	0	0.69	0	0	0
40 to 70	3.80	0	0	0	0	0
70 to 100	39.68	100.00	22.95	0.10	0.34	0
Pajarito Canyon						
0 to 10	20.12	10.90	25.24	56.92	73.98	28.92
10 to 40	75.03	81.95	67.12	41.55	24.36	67.49
40 to 70	4.14	7.15	5.13	1.37	1.31	3.52
70 to 100	0.71	0	2.51	0.16	0.35	0.07
Sandia Canyon						
0 to 10	81.09	100.00	78.34	95.75	99.79	73.05
10 to 40	18.91	0	21.66	4.25	0.21	26.95
40 to 70	0	0	0	0	0	0
70 to 100	0	0	0	0	0	0
Mortandad Canyon						
0 to 10	0	100.00	20.80	51.18	63.01	15.63
10 to 40	87.73	0	69.82	41.00	31.72	82.19
40 to 70	12.27	0	9.38	7.82	5.27	2.18
70 to 100	0	0	0	0	0	0
Water Canyon						
0 to 10	28.11	26.54	36.74	91.71	98.09	26.34
10 to 40	69.80	38.87	53.71	6.90	1.29	56.41
40 to 70	2.09	34.59	9.55	1.39	0.62	17.25
70 to 100	0	0	0	0	0	0

3.6.2.2 Federal and State Listed Threatened and Endangered Species Conditions

Table 3.6 lists four federally-listed species that may be located within LANL boundaries or nearby. The Cerro Grande Fire did not severely burn the T&E species areas of environmental interest (AEIs) on LANL, although many of the Mexican spotted owl AEIs received moderate- and low-severity burns (Table 3.7). Habitat within the Southwestern Willow Flycatcher AEI and Bald Eagle AEI did not burn.

TABLE 3.6–*Federal Threatened or Endangered Species Considered under the Fire Suppression Activities and Emergency Actions*

Common Name	Scientific Name	Status*	Habitat
Mexican spotted owl	*Strix occidentalis lucida*	FT	Ponderosa pine and mixed conifer forests. Uneven-aged, multistoried forests with closed canopies.
Bald eagle	*Haliaeetus leucocephalus*	FT	Roosts in riparian areas near streams and lakes.
Southwestern willow flycatcher	*Empidonax traillii extimus*	FE	Nests in riparian areas with willows and cottonwoods.
Whooping crane	*Grus americana*	FE	Sandbars and wetlands. Uses White Rock Canyon during migration.

FE = Federally listed as Endangered, FT = Federally listed as Threatened

TABLE 3.7–*Total Percentage of Vegetation Mortality within the Core Area of each Mexican Spotted Owl AEI**

Location (%)	Mixed Conifer (%)	Aspen (%)	Ponderosa Pine (%)	Piñon/ Juniper (%)	Juniper Woodland (%)	Grassland (%)
Los Alamos Canyon						
0 to 10	48.49	79.01	60.51	99.79	100.00	98.42
10 to 40	1.54	0.71	0.64	0	0	0
40 to 70	12.62	2.24	0.65	0	0	0.31
70 to 100	37.35	18.04	38.20	0.21	0	1.27
Sandia Canyon/Mortandad Canyon						
0 to 10	52.93	0	38.78	51.26	81.36	26.14
10 to 40	47.07	100.00	61.22	48.74	18.64	73.86
40 to 70	0	0	0	0	0	0
70 to 100	0	0	0	0	0	0
Pajarito Canyon						
0 to 10	0	0	0.03	0	0	0
10 to 40	93.95	100.00	89.78	96.72	100.00	100.00
40 to 70	6.05	0	10.19	3.28	0	0
70 to 100	0	0	0	0	0	0
Cañon de Valle						
0 to 10	26.92	47.46	39.76	83.02	100.00	4.37
10 to 40	73.08	52.54	60.24	16.98	0	95.63
40 to 70	0	0	0	0	0	0
70 to 100	0	0	0	0	0	0
Three Mile Canyon						
0 to 10	0	0	0.02	3.02	0	0
10 to 40	100.00	100.00	99.98	96.98	100.00	100.00
40 to 70	0	0	0	0	0	0
70 to 100	0	0	0	0	0	0

* Pueblo Canyon AEI is not included in this table because there was no vegetation mortality.

Some federally-protected species have historically inhabited areas in the vicinity of LANL but are no longer present. The black-footed ferret (*Mustela nigripes*) has a historical range that includes 12 states (Arizona, Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming) and the Canadian provinces of Alberta and Saskatchewan. Black-footed ferrets depend almost exclusively on prairie dogs for food and shelter. Ferret range is coincident with that of prairie dogs, with no documentation of black-footed ferrets breeding outside of

prairie dog colonies. Only prairie dog colonies with a combined area greater than 80 ac (32 ha) are large enough to support black-footed ferrets. There are no prairie dog colonies of the appropriate size in LANL and black-footed ferrets are therefore not discussed further in this document.

Potential habitat for American peregrine falcon (*Falco peregrinus anatum*) exists within LANL boundaries. Recently, the peregrine falcon was removed from the Federal List of Endangered and Threatened Wildlife. DOE is required to track potential effects to de-listed species for five years, thus DOE will continue to track the potential effect to peregrine falcon habitat until the end of 2004.

The State of New Mexico *Wildlife Conservation Act* (NMSA 1978a) states that "it is unlawful for any person to take (harass, hunt, capture, or kill any wildlife or attempt to do so), possess, transport, export, process, sell or offer for sale or ship any species of wildlife appearing on any of the following lists." This provision applies only to species identified as endangered. State T&E species are identified in Table 3.8. There are no known plants on LANL that are listed as endangered plant species in New Mexico (NMSA 1978b). State-endangered species listed in Table 3.8 are protected from certain activities.

TABLE 3.8–*New Mexico Threatened and Endangered Species Potentially Occurring in the Area of Fire Suppression and Emergency Actions*

Scientific Name	Common Name	New Mexico Status*	Habitat	Potential to Occur⊗
Pisidium lilljeborgi	Lilljeborg's pea-clam	NMT	Habitats include lakes, occurring at higher latitudes and altitudes. The New Mexico population of the species occurs in cold, alpine Nambe Lake, which is located in a glacial cirque.	Low
Stagnicola caperatus	Wrinkled marsh snail	NME	High-elevation emergent wetlands.	Low
Plethodon neomexicanus	Jemez Mountains salamander	NMT	Shady, wooded, spruce-fir dominated sites at elevations of 7,200 to 9,200 ft (2,190 to 2,800 m).	Moderate
Aegolius funereus	Boreal owl	NMT	Relatively inaccessible mature to old growth spruce-fir forests.	Low
Cynanthus latirostris magicus	Broad-billed hummingbird	NMT	Primarily in riparian woodlands at low to moderate elevations.	Low
Lagopus leucurus altipetens	White-tailed ptarmigan	NME	Inhabits alpine tundra and timberline habitats, which in New Mexico are mainly above 10,500 ft (3,201 m).	Low
Vireo vicinior	Gray vireo	NMT	Open piñon-juniper and oak woodlands.	Moderate
Ammodramus bairdii	Baird's sparrow	NMT	Found in New Mexico in a variety of habitats, ranging from desert grasslands in the south to mountain meadows in the San Juan and Sangre de Cristo mountains—up to an elevation of 11,800 ft (3,540 m).	Low
Falco peregrinus anatum	American peregrine falcon	NMT	Uses juniper savannah, piñon-juniper woodland, ponderosa pine forest, and mixed-conifer forests. Requires cliffs for nesting.	High

TABLE 3.8—*Continued*

Scientific Name	Common Name	New Mexico Status*	Habitat	Potential to Occur⊗
Haliaeetus leucocephalus	Bald eagle	NMT	Roosts in riparian areas near streams and lakes.	High
Grus americana	Whooping crane	NME	Uses sandbars and wetlands including White Rock Canyon during migration.	Low
Empidonax traillii extimus	Southwestern willow flycatcher	NME	Nests in riparian areas with willows and cottonwoods.	Moderate to High
Euderma maculatum	Spotted bat	NMT	Found in a wide variety of habitats, from riparian to ponderosa pine and spruce-fir forests.	High
Martes americana origenes	American marten	NMT	Found in late successional spruce-fir forests.	Low
Zapus hudsonius luteus	New Mexican jumping mouse	NMT	In both the Jemez Mountains and the Rio Grande Valley, preferred habitat contains permanent streams, moderate to high soil moisture, and dense and diverse streamside vegetation consisting of grasses, sedges, and forbs.	Moderate

*CODES FOR LEGAL STATUS
NME = New Mexico endangered
NMT = New Mexico threatened

⊗ POTENTIAL TO OCCUR
High = species is known to occur in the area
Moderate = the area has some species habitat components
Low = the area does not have species habitat components

3.6.2.3 Other Wildlife

The effects of the Cerro Grande Fire on wildlife at LANL are expected to be similar to those experienced in other portions of the ROI. Elk, deer, and human interface problems are expected to increase at LANL.

3.7 Climatology, Meteorology, and Air Quality

Los Alamos has a semiarid, temperate mountain climate. Meteorological conditions within the Los Alamos area are influenced by the elevation and the ruggedness of the Pajarito Plateau. The climate is characterized by seasonable, variable rainfall with precipitation ranging from 10 to 20 in. (25 to 51 cm) per year. The normal annual precipitation for Los Alamos for the period 1961 to 1990 was about 19 in. (48 cm). The Jemez Mountains receive over 25 in. (64 cm) annually. The heaviest precipitation occurs during the months of July, August, and September (1999 LANL SWEIS, Section 4.41). Although there have been no known instances of large-scale flooding as a result of rainfall, there have been infrequent episodes of localized flooding during heavy downpours (1999 LANL SWEIS, Section 4.4.1.2). The conditions discussed in the 1999 LANL SWEIS constitute the climatological and meteorological baseline for this analysis.

The 1999 LANL SWEIS describes the air quality of the Los Alamos area and analyzes the impact of LANL operations on the regional air quality. It also analyzed consequences from wildfire at LANL. In contrast to the SWEIS accident analysis, emissions reported from the Cerro Grande Fire represented the entire area burned, which included LANL, Santa Fe National Forest, Los Alamos County, Santa Clara Pueblo and San Ildefonso Pueblo lands, and various private landholdings. Several organizations (UC, DOE, EPA,

and NMED) analyzed samples of the smoke plume for both chemical and radioactive constituents. Monitoring data indicated that the emissions were consistent with those expected from burning natural vegetation and soils (LANL 2000b).

The Cerro Grande Fire's primary effect on air quality in the ROI was a temporary increase in smoke (Photo 3.3) and increased concentrations of radioactive constituents, particulate matter, and other chemicals (discussed in following paragraphs). The only longer-term effect is a probable increase in suspended particulate matter due to removal of vegetation; over the longer term (one to three years), the loss of vegetative cover would increase the likelihood that particulate matter would become airborne. Until vegetation is re-established, the amount of suspended particulates could increase, but air quality would still be within the parameters analyzed in the 1999 LANL SWEIS.

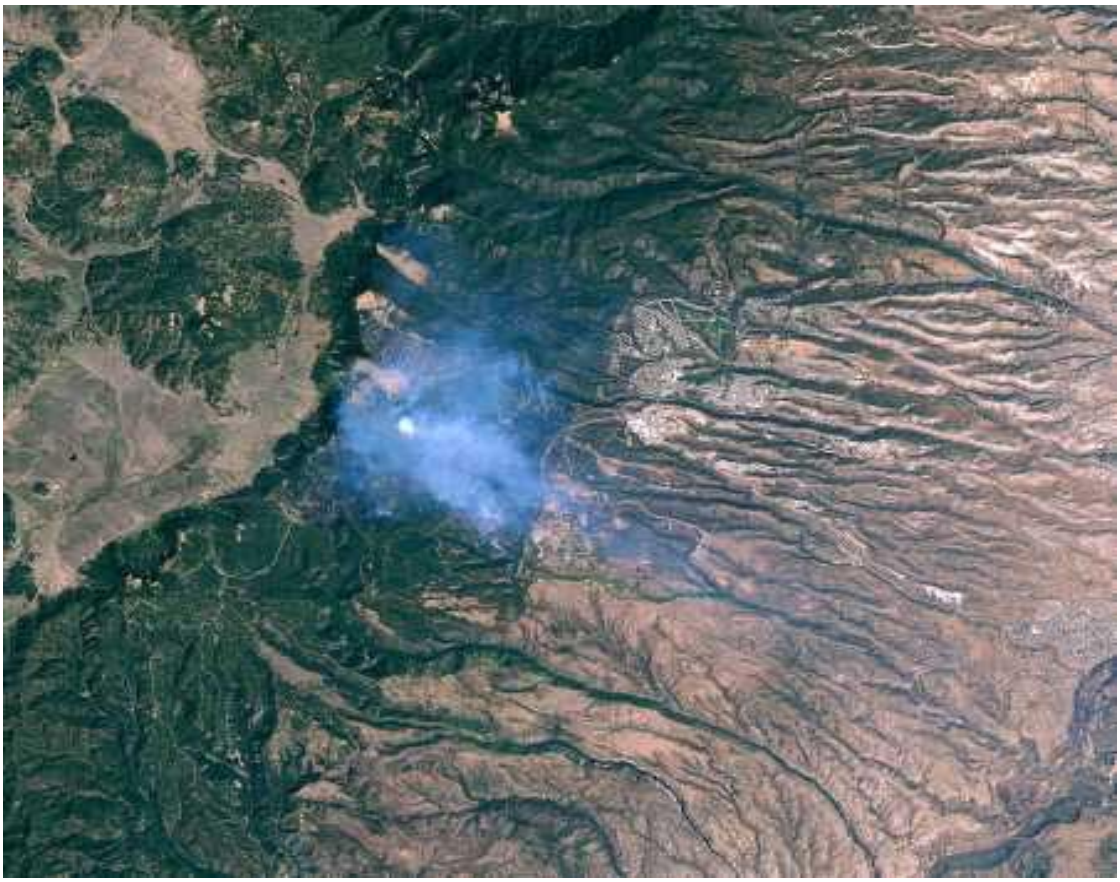

PHOTO 3.3—*Smoke from the Cerro Grande Fire Spreads Eastward toward LANL*

Radiological emissions were produced during the Cerro Grande Fire. Most wildfires, regardless of location, emit radioactive lead-210, bismuth-210, and polonium-210, which are naturally occurring decay products of radon. Radon is a gas, but these decay products are metals that settle to the ground and on plant surfaces. During a fire, these metal particles (from soil and vegetation) become airborne in greater than normal concentrations. Other radionuclides are also present naturally (potassium-40, carbon-14, beryllium-7, and uranium). In addition, human-made radioisotopes are expected in small

quantities from world wide fallout resulting from historical atmospheric testing and weapons use (Rea 2000). Radioactive emissions from the Cerro Grande Fire were similar to those from similar fires in other areas of the world. Details of radioactive emissions are presented in *Wildfire 2000* (LANL 2000b).

Nonradiological emissions resulted from the Cerro Grande Fire. Typically, smoke from forest fires contains large amounts of particulates, carbon dioxide, and water vapor. Particulate matter emissions factors range from 4 to 180 pounds per ton of fuel. The size of particulates produced by a wildfire range from an average of 0.3 microns to greater than 10 microns depending on the fire intensity and the length of the fire's leading edge (Rea 2000). In a large, hot fire like the Cerro Grande Fire, particulates tend to be larger (>10 microns). Monitoring stations recorded higher than normal concentrations of PM-10 (particulates smaller than 10 microns) during the fire. All sampling networks showed higher-than-normal air concentrations of particulate matter associated with smoke from the fire. LANL's sampling station at TA-54 detected PM-10 at slightly higher than normal concentrations until the fire was very close to TA-54. On those days, air concentrations as high as 1,000 micrograms per cubic meter ($\mu g/m^3$) were measured because of the monitoring station's proximity to the fire and the smoke plume.

In addition to particulate matter, carbon dioxide, and water vapor, fires produce varying amounts of carbon monoxide, hydrocarbons, and other complex organic compounds. Nitrogen oxide and hydrocarbons react together in the presence of ultraviolet light to produce ozone and organic oxidants. Carbon monoxide is produced in lesser quantities (70 pounds/ton of fuel) during open burning periods of a wildfire than in the smoldering periods, which can produce up to 800 pounds/ton of fuel (Rea 2000). As the fire was suppressed, emissions of carbon monoxide would have temporarily increased in areas of smoldering vegetation.

Metals and organic compounds were detected by air monitors at LANL, but at concentrations that did not pose a health risk. No pesticides were detected. Metals were present in small quantities; sampling showed very low concentrations and quantities measured were well below accepted workplace concentrations. These air-borne metals appeared to be attributable to burning vegetation. Of the 12 organic compounds detected, the highest observed concentration was less than 10 percent of the prescribed workplace standard (LANL 2000b). Monitoring in the vicinity of MDA-R indicated that the burning materials at MDA-R produced air-borne pollutants at levels that were below applicable occupational exposure limits (Eklund 2000). Asbestos was detected but the highest concentrations were about ten percent of the Occupational Safety and Health Administration asbestos limit (LANL 2000b).

3.8 Visual Resources

The 1999 LANL SWEIS defines the LANL viewshed as the region from which an observer can potentially view LANL. Discussion of the existing visual environment is based on this regional viewshed. Conditions described in the 1999 LANL SWEIS still generally apply to the ROI for visual resources issues.

The LANL viewshed is diverse, interesting, and panoramic (1999 LANL SWEIS). Long-distance views of LANL and the Jemez Mountains have not been affected by the Cerro Grande Fire. Although the fire destroyed some vegetation, LANL facilities are still generally screened from the view of passing motorists. Very tall structures and high-visibility facilities such as the water towers and waste domes at TA-54 are still prominent in the viewshed. Light from LANL facilities contributes less night-time light pollution than does the Los Alamos townsite or community of White Rock (1999 LANL SWEIS). The Cerro Grande Fire did not alter the respective contribution of LANL and the surrounding communities to night-time light pollution.

Views from various locations in Los Alamos County and its immediate surroundings have been altered by the Cerro Grande Fire. Although the visual environment is still diverse, interesting, and panoramic, portions of the visual landscape are dramatically stark (Photo 3.4). Rocky outcrops forming the mountains are now visible through the burned forest areas. The eastern slopes of the Jemez Mountains, instead of presenting a relatively uniform view of dense green forest, are now a mosaic of burned and unburned areas. Grasses and shrubs initially will replace forest stands and will contribute to the visual contrast between the burned and unburned areas for many years.

PHOTO 3.4—*Severely Burned Mountain Slopes above Los Alamos Townsite*

In addition to effects on panoramic views, the Cerro Grande Fire also had local effects. Destruction of vegetation, erosion, and deposition of charcoal-laden sediments along stream channels have severely affected the visual appeal of trails and recreation areas. New vegetation growth is expected to moderate these effects over a period of years.

3.9 Cultural Resources

The ROI for cultural resource issues is limited to the boundaries of LANL. Cultural resources downstream from LANL have not been inventoried. Any downstream cultural sites should not be affected by the flood and erosion retention projects discussed in this SEA, as off-site water flow is expected to remain within historic levels.

Over 2,000 archaeological sites and historic properties have been identified at LANL. Some of these sites consist of artifact scatters that reflect the ephemeral remains of ancient hunting campsites, while others include the Manhattan Project buildings where the Atomic Age began.

As of 1999, a total of approximately 19,000 ac (7,600 ha) at LANL had been 100 percent surveyed. This represents about 68 percent of the LANL facility. Sixteen hundred prehistoric archaeological sites have been recorded, for a site density of about one site per 10 ac (4 ha). There are also about 100 sites that date to the Homestead Era from the turn-of-the-century to the 1940s and 500 buildings that were constructed during the Manhattan Project or Cold War Eras (1943–1956). Twenty-three federally recognized tribes and two affected Hispanic communities claim traditional use of LANL lands. For example, one claim asserts that these lands are located within the ancestral domain of San Ildefonso Pueblo. As such, the Pueblo recognizes several of the large prehistoric villages at LANL as ancestral homes.

Approximately 1,500 prehistoric and historic sites, buildings, and structures have been considered eligible for inclusion in the National Register of Historic Places (NRHP) under the *National Historic Preservation Act* (NHPA). Under the NHPA, cultural resources undergo an evaluation process that determines if the resource is eligible for listing on the NRHP. Resources that are already listed, determined eligible for listing, or have an undetermined status are afforded a level of consideration under the NHPA Section 106 process. In order to be determined eligible for inclusion in the NRHP, a resource must meet one or more of the criteria found in 36 CFR Part 60 as follows:

- Criterion A: Associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B: Associated with the lives of people significant in our past.
- Criterion C: Embodies the distinctive characteristics of a type, period, or method of construction.
- Criterion D: Yielded or may be likely to yield information important in prehistory or history.

The resource also must retain most, if not all, of seven aspects of integrity of location, design, setting, materials, workmanship, feeling, and association.

The Cerro Grande Fire affected 304 prehistoric and 58 historic (including Manhattan Project) recorded sites (Table 3.9). The impacts to prehistoric sites from the fire are not fully known. Vegetation was burned off some of these sites. Burned out tree root systems have formed conduits for modern debris and water to mix with subsurface archaeological deposits. They also provide an entry point for burrowing animals. Snags

or dead or dying trees may fall and pull out deposits including wall stones that are enmeshed in the tree roots. Post-fire surveys of cultural resources within the burn area have been initiated.

TABLE 3.9—*Cultural Resources within Burned Areas and Pre-fire 100-Year Floodplain*

Watersheds	Burned Areas		Pre-fire 100-Year Floodplain	
	Prehistoric	Historic	Prehistoric	Historic
Los Alamos	0	0	0	0
Pajarito	76	37	1	3
Water	113	6	3	1
Mortandad	62	12	3	1
Sandia	14	1	0	0
Rendija	39	2	0	0
Total	304	58	0	0

Historic resources within the burned area were severely adversely impacted. Many wooden structures from the Homestead Era and from the Manhattan Project/Cold War period and various Manhattan Project artifacts were destroyed (Table 3.10).

TABLE 3.10—*Historic Resources Affected by Cerro Grande Fire or Post-fire Flooding*

Structure	Type	Condition
Montoya y Gomez Cabin Site (LA 21334)	Homestead Era	Buildings destroyed by fire
Gomez Homestead (LA 86643)	Homestead Era	Buildings destroyed by fire
Upper Pajarito Canyon Bridge (LA 89826)	Homestead Era	Buildings destroyed by fire
Grant Homestead (LA 16807)	Homestead Era	Buildings destroyed by fire
David Romero Homestead (LA 16806B)	Homestead Era	Light fire damage to ground surrounding the site
Anchor Ranch icehouse (LA 16808)	Homestead Era	Building destroyed by June 28, 2000 (post-fire) flood
TA-6	Manhattan Project Era –wooden structural remains	Two structures destroyed by fire
TA-16-515 TA-16-516 TA-16-518 TA-16-519 TA-16-520	Manhattan Project Era – part of "V-Site"	Buildings and artifacts destroyed by fire
TA-40-72 TA-40-73	Manhattan Project Era- wooden storage buildings	Buildings destroyed by fire
TA-7 (now part of TA-6)	Manhattan Project/Cold War period – firing sites	Wooden elements destroyed by fire
TA-16-372	Cold War period – wooden cooling tower	Building destroyed by fire
TA-15-50	Cold War period – staff shop, part of complex known as "The Hollow"	Building destroyed by fire

There has been a significant loss of Homestead Era historic sites in the Jemez Mountains/Pajarito Plateau area as a result of the Cerro Grande Fire and previous wildfires such as the Dome Fire in 1996. The structural remains associated with the homesteads are rapidly dwindling throughout the region. Before the fire, LANL's historic homesteads were among the best remaining evidence of this period. Virtually all wooden buildings associated with the Homestead Era were destroyed by the fire and the sites were largely reduced to rubble. On June 28, 2000, an intense rain also produced

flooding that destroyed an already deteriorating Homestead Era icehouse structure (Photos 3.5 and 3.6).

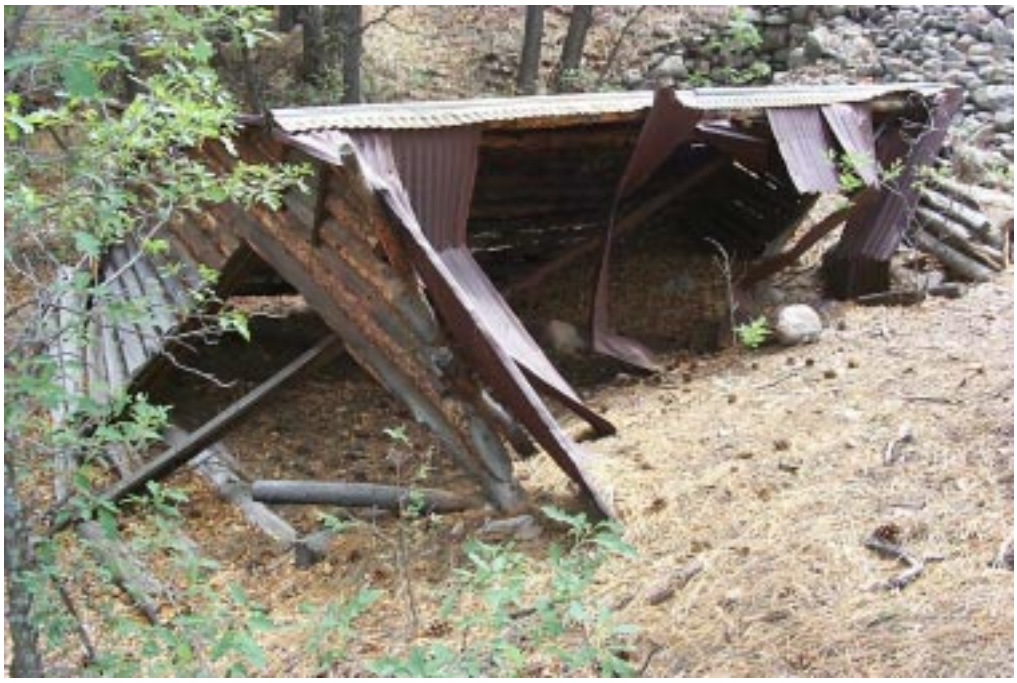

PHOTO 3.5—*Anchor Ranch Icehouse before June 28, 2000, Flooding*

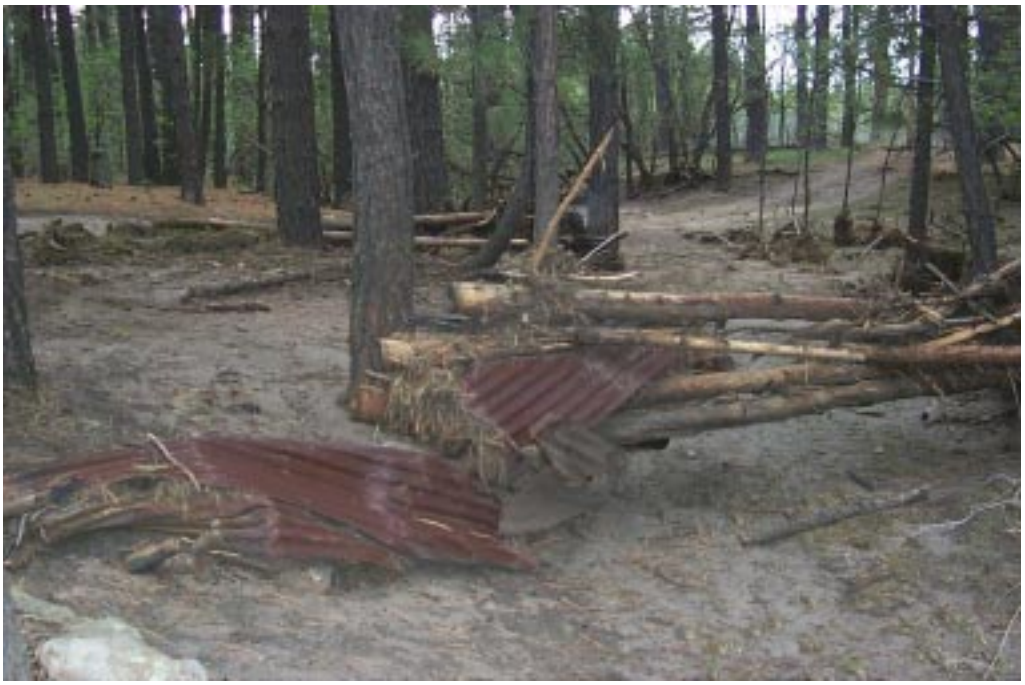

PHOTO 3.6—*Anchor Ranch Icehouse after Flooding*

The fire also destroyed most of the V-Site structures that remained from the Manhattan Project Era. The Manhattan Project and the development of the atomic bomb became one of the most extraordinary scientific undertakings in the history of humankind. Many

of the world's best physicists, mathematicians, and engineers lived and worked on the top-secret plateau that would come to be known as Los Alamos. The V-Site was typical of the wooden laboratories built in Los Alamos for the Manhattan Project. A cluster of clapboard wooden buildings, the V-Site was among the last vestiges of the Manhattan Project at Los Alamos. In these buildings, scientists worked on the "Gadget" (Trinity device), the world's first successful nuclear detonation, which was the prototype for the bomb that was detonated over Nagasaki, Japan, on August 9, 1945.

The V-Site was abandoned in the early 1950s, and its buildings were slated for demolition. However, in May 1999, the White House Millennium Council awarded the V-Site a grant under the Save America's Treasures program to restore, preserve, and use these buildings as a museum and interpretive center for the Manhattan Project. The Cerro Grande Fire largely destroyed portions of this site and its remaining artifacts. Photos 3.7 and 3.8 illustrate the "before" and "after" effects of the fire.

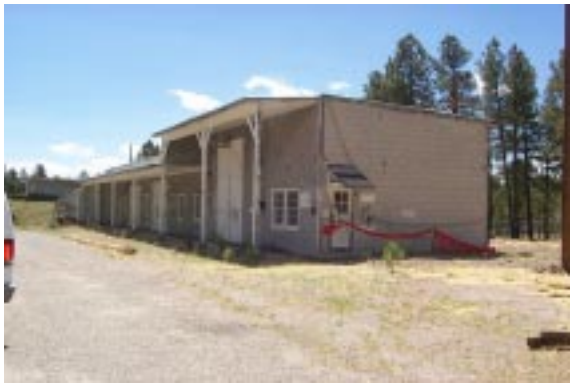

PHOTO 3.7—*V-Site in 1999*

PHOTO 3.8—*Portion of V-Site Destroyed in the Cerro Grande Fire*

All but one building of the Manhattan Era V-Site was destroyed by the fire. Program planning was underway to restore the V-Site buildings, build a road into the site to allow public access, and create a world-class interpretive center and museum on the history of the Manhattan Project before the Cerro Grande Fire. The V-Site renovation was being collaboratively undertaken by DOE, LANL, the Bradbury Science Museum, and Recursos de Santa Fe. Historic artifacts associated with a former casting building at TA-16-27 were stored in TA-16-518, a long wooden shed at V-Site. Most of the artifacts were destroyed and the artifacts that remain have fire damage. The program planning is now being revised because of the cultural resources changes at LANL attributed to the fire.

As stated in the 1999 LANL SWEIS, on-site impacts to TCPs are possible throughout LANL and are likely in the wake of the Cerro Grande Fire. The locational information to fully analyze impacts to TCPs is insufficient at this time. DOE and UC have recently drafted *A Comprehensive Plan for the Consideration of Traditional Cultural Properties and Sacred Sites at Los Alamos National Laboratory, New Mexico* (DOE 2000). This plan outlines consultation requirements, regulatory considerations, confidentiality and protocol issues, and long-term management considerations. When finalized this plan will

be used in consultation efforts associated with effects from the Cerro Grande Fire and resulting flood damage.

3.10 Utilities and Infrastructure

Section 4.9.2 of the 1999 LANL SWEIS describes utility and infrastructure services at LANL before the Cerro Grande Fire. The utilities and infrastructure in and around LANL under the Preferred Alternative selected in the SWEIS ROD are described in detail in Section 5.5.9.2 of the SWEIS. The ROI includes both LANL and Los Alamos County.

Ownership and distribution of utility services is split between DOE and Los Alamos County. Utility systems at LANL include electrical service, natural gas, steam, water, sanitary wastewater, and refuse. Ongoing maintenance of power line corridors includes thinning and clearing low-lying vegetation and topping off tall trees. This type of maintenance provides easy access and protects the power line from potential fire and storm-related danger. Safeguards and security operations are conducted at LANL to provide protection of national security interests, proprietary information, government property, and the general public. Vegetation, such as trees, is used at LANL to enhance buffer areas for operational and security purposes. Facility fire protection programs at LANL ensure that personnel and property are adequately protected against fire or related incidents. Interagency agreements between Los Alamos County and DOE are in place to share water supplies, equipment, and personnel as required to perform facility fire protection.

Gas and electric services to LANL and the surrounding communities were shut off or were interrupted during the fire. Utility services to LANL facilities were mostly unchanged by the fire although several of the short electric feeder lines were destroyed and some phone lines were melted. During the Cerro Grande Fire, a total of 86 power pole structures at LANL were destroyed or damaged and the Static Var Compensator was shut down. Because water tanks were drained during the fire by firefighters, mineral deposits were drawn into the lines at LANL. No other utility services received any major damage. Approximately 240 structures (including trailers, transportables or other storage buildings, and miscellaneous structures, such as electric power pole structures) were damaged during the fire. Of this number, about 40 were totally destroyed (LANL 2000e).

3.11 Socioeconomics

Section 4.9.1 of the 1999 LANL SWEIS describes socioeconomic conditions at LANL before the Cerro Grande Fire. The impacts on the socioeconomic conditions in and around LANL under the Preferred Alternative selected in the SWEIS ROD are described in detail in Section 5.5.9.1 of the 1999 LANL SWEIS.

The ROI for socioeconomic issues includes the geographic area most affected by LANL and is the region comprised of Los Alamos, Santa Fe, and Rio Arriba counties. Demographic, social, and economic conditions are summarized here and described in detail in the 1999 LANL SWEIS in Section 4.9.1. Population data from the most recent

1990 Census show about 18,000 people in Los Alamos County, 99,000 people in Santa Fe County, and 34,500 people in Rio Arriba County. UC remains the largest employer in the tri-county region. For fiscal year (FY) 1997, the DOE operations funding amount for LANL was $1,105.4 million (actual cost); this funding supported 6,855 full-time equivalent personnel (LANL 1998). During FY 1997, UC spent a total of $723.0 million for external subcontracts and procurements. Of this total, $294.0 million were spent on small and disadvantaged businesses. A detailed description of the community infrastructure and social services, which includes (pre-Cerro Grande Fire) data on local government finances, the number of housing units, public schools, health services, police protection, fire protection, and utilities, is included in the 1999 LANL SWEIS.

No long-term or major effects on the socioeconomic condition of the region resulted because of the fire. During and subsequent to the Cerro Grande Fire, about 230 residential structures were destroyed or damaged and utility services burned in the western and northern portions of Los Alamos. Businesses were closed for at least a week resulting in economic loss to them and the County. Federal legislation for funds is anticipated to provide some recompense to individual homeowners, renters, and business operators. There will be short-term increases in employment generated by construction activity to rebuild houses destroyed or damaged by the fire, primarily within the townsite.

Employment at LANL during and subsequent to the Cerro Grande Fire remained constant. DOE, UC, its subcontractors, and other contract staff were paid during the shutdown from the fire and no jobs were lost.

3.12 Noise

Section 4.1.3 of the 1999 LANL SWEIS provides a definition of noise and a description of the noise environment at LANL before the Cerro Grande Fire. The impacts on the noise environment in and around LANL under the Preferred Alternative selected in the SWEIS ROD are described in detail in Section 5.3.1.3 of the SWEIS.

Activities associated with the Cerro Grande Fire resulted in localized, minor, and temporary increases in noise levels. However, the fire damaged or destroyed approximately 43,000 ac (17,200 ha) of forest land, of which about 7,650 ac (3,000 ha) were located within the boundaries of LANL (see Figure 1.2, page 1-3). The damage or loss of large forest areas has an adverse effect on the ability of the surrounding environment to absorb noise. However, the types of noise and noise levels associated with operations at LANL and from activities in surrounding communities have not changed significantly as a result of the fire.

3.13 Environmental Justice

Environmental justice impacts are assessed for a 50-mi (80-km) area surrounding LANL (the ROI for environmental justice issues). Detailed minority and low-income distribution data are available in the 1999 LANL SWEIS in Section 4.7 and have not changed as a result of the Cerro Grande Fire. The impacts on environmental justice in the region under the Preferred Alternative selected in the SWEIS ROD are described in

detail in Section 5.3.7. Maps showing the distribution of both low-income and minority populations are shown on pages 4-150 and 4-151 of the 1999 LANL SWEIS.

3.14 Human Health

Section 4.6 of the 1999 LANL SWEIS provides a detailed summary of public and worker health in and around LANL before the Cerro Grande Fire. The ROI for human health issues and affected workforce is also described in this section. The impacts on human health under the Preferred Alternative selected in the SWEIS ROD are described in detail in Section 5.3.6. The *Wildfire 2000* publication (LANL 2000b) includes a detailed comparison of the SWEIS analysis of the wildfire accident scenario and the actual Cerro Grande Fire event.

The Cerro Grande Fire had a minimal effect on public and worker health. The fire produced large amounts of smoke; however, most of the nearby community had been evacuated before the fire reached DOE-administered lands. One smoke inhalation related injury to a LANL employee was recorded during the fire suppression period. No specific fire-related injuries or fatalities occurred to any members of the public or to DOE employees. Two minor injuries occurred to emergency response personnel. Preliminary estimates of radiation dose to the public indicate that members of the public received less than 1.0 millirem (mrem) from smoke exposure from the fire (LANL 2000b). In addition, preliminary and limited results from storm water runoff monitoring indicate that concentrations of plutonium-239 and other radionuclides are below allowable concentrations for public drinking water (LANL 2000f). Although storm water runoff is not used for drinking water at or in the vicinity of LANL, this standard is applied for the sake of perspective and as a conservative resource management measure.

UC expanded its soil and produce monitoring program for local farms downwind from the Cerro Grande Fire and from LANL. Based on available sample data for radionuclides, radioactivity, trace elements, and organic constituents, there were no significant impacts to soils at local farms.

Based upon actual recorded injuries, estimated radiation doses, and concentrations of radionuclides in storm water, the affected environment for public and worker health did not change appreciably as a result of the Cerro Grande Fire from the status described in the 1999 LANL SWEIS.

3.15 Environmental Restoration and Waste Management

3.15.1 Environmental Restoration at LANL

The Environmental Restoration Project at LANL was established by DOE in 1989 to assess and remediate (clean up) potentially contaminated sites that either were, or are, under DOE administration at LANL. Approximately 2,120 sites have been identified at LANL. These sites are a combination of solid waste management units identified in the RCRA permit for LANL or potentially contaminated sites called areas of concern (AOCs). Some AOCs may contain radionuclides and hazardous constituents that are not

regulated under RCRA. As of September 1997, 1,370 of these sites have been identified as requiring no further action based on human health concerns.

PRSs at LANL include past material disposal areas (MDAs, landfills), canyons, drain lines, firing sites, outfalls, and other random sites such as spill locations. The primary mechanisms for contaminant release from these sites are surface water runoff carrying potentially contaminated sediments and soil erosion exposing buried contaminants. The main pathways by which released contaminants can travel off-site are through infiltration into alluvial aquifers, airborne dispersion of particulate matter, and sediment migration from surface water runoff. The contaminants involved include volatile and semivolatile organics, polychlorinated biphenyls (PCBs), asbestos, pesticides, herbicides, heavy metals, beryllium, radionuclides, petroleum products, and high explosives. The 1999 LANL SWEIS contains additional contaminant information.

A total of 626 PRSs were in the area burned by the Cerro Grande Fire. Of these, 308 PRSs were actually burned. In some cases, existing BMPs were damaged and vegetation was removed by the fire. In addition, some of the 77 PRSs outside the fire perimeter within floodplains were determined to be of increased risk of potential flood or erosion damage.

3.15.2 Waste Management

Section 4.9.3 of the 1999 LANL SWEIS describes the waste management activities in and around LANL before the Cerro Grande Fire. The impacts on waste management in and around LANL under the Preferred Alternative selected in the SWEIS ROD are described in detail in Section 5.3.9.3 of the SWEIS.

UC employs a variety of strategies to manage waste generated at LANL. Solid waste, including construction rubble, goes primarily to the Los Alamos County Landfill; certain classified waste goes to a classified landfill at TA-54. The SWEIS ROD included the expansion of the current on-site disposal of LANL-generated low-level waste that used the existing footprint at the Area G low-level waste disposal area and expanded disposal capacity into Zones 4 and 6 at Area G. Hazardous waste is shipped off-site. Low-level radioactive waste is disposed of at TA-54, Area G, or shipped off-site. Transuranic waste is stored at TA-54 before being shipped to the Waste Isolation Pilot Project plant near Carlsbad, New Mexico, if defense related. Mixed waste is stored at TA-54 pending development of suitable waste disposal alternatives.

The Cerro Grande Fire resulted in an increased volume of solid waste at the Los Alamos County Landfill and other regional landfills from cleanup and removal of burned residential and other utility structures in Los Alamos. Solid waste volumes from commercial and residential areas and LANL during the period of the fire were negligible because of the two- to three-week period that LANL and the townsite were shut down or evacuated. Sanitary waste water volumes were similarly affected by the fire.

3.16 Transportation

Section 4.10 of the 1999 LANL SWEIS describes transportation services at LANL before the Cerro Grande Fire. The impacts on transportation in and around LANL under the Preferred Alternative selected in the SWEIS ROD are described in detail in Section 5.3.10 of the SWEIS.

Regional and site transportation routes are the primary methods used to transport LANL-affiliated employees, commercial shipments, and hazardous and radioactive material shipments. Bladed (unpaved) fire roads are located in many areas of LANL and are often used as access roads for maintaining utility services. During fire protection maintenance operations, some road closures were necessary. The Cerro Grande Fire damage to the transportation system was minimal; some guard rails were damaged or destroyed by the fire along SR 4 and SR 501.

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